

Reliability Test Station

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G A T O R
Engineering



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Overview

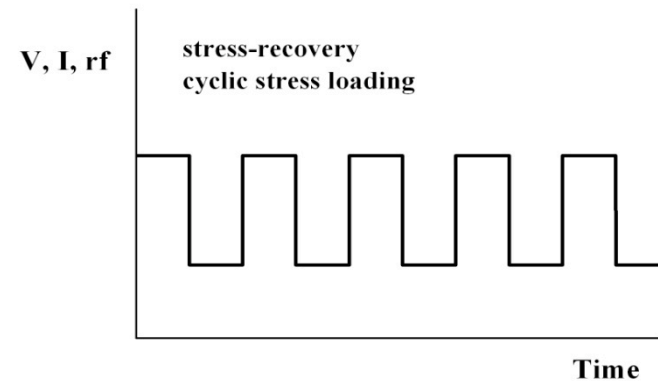
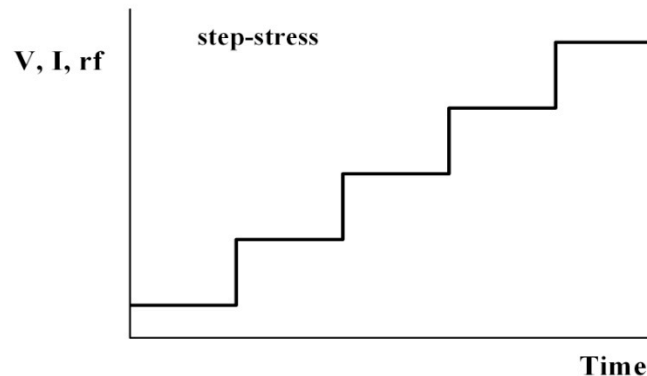
- Turnkey vs. In-house
- Electrical Stress Protocols
- System Specifications & Features
- UF Semiconductor Reliability System
- Development

Turnkey vs. In-house

	Turnkey		In-house
Timeline	Purchase lead time		On-going
System	Proven		Custom design
Objective	Determine Lifetimes		Research Determine failure mechanisms
Test Types	Industry standards		Flexible
DC Drain Gate	0-100V, up to 4A, 400W max ±18.5V, up to 200mA		0-60V, up to 6A, 300W max ±10V, up to 20mA
RF	600MHz-3 GHz 2-18 GHz 58-60 GHz	900MHz-10GHz 36-40 GHz 76-78 GHz	1.8-2.2 GHz expandable with additional hardware
Temperature	50° to 250° C		25° to 250° C
Optical	NA		Research with wavelength and intensity
Thermal Imaging	NA		IR, Micro Ramon additional hardware
Pulse	1-100kHz		Up to 80MHz
Data Storage	Independent test files		SQL database

Electrical Stress Protocols

- Look for dominant factor causing degradation and is there recovery during OFF-state (trap generation)
- ambient (oxidation, hydrogen effects)
- Field distributions (including inspection of non-uniformity in gate dimensions)
- Visual inspection, dc, rf, base noise spectra (f,V)-check for high leakage, etc.
- Define failure(eg. often 10-20%) degradation in HBT current)

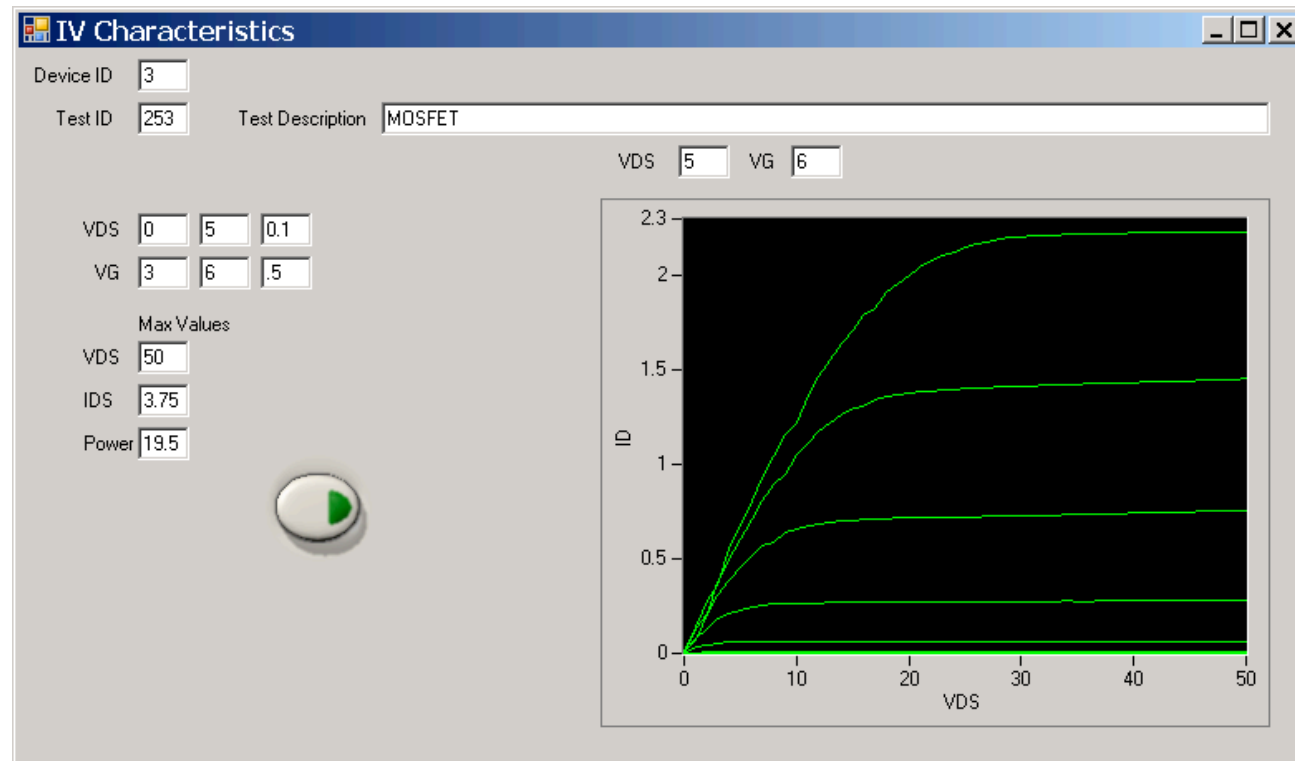


System Specifications & Features

- 32 Device Capacity
- Long-term DC Stress
 - Individual gate bias control ($\pm 10\text{Vdc}$ up to 20mA)
 - Drain bias control (0-60Vdc, up to 6A, 300W max)
 - Pulse, step, pulse-step control
- RF Stress
 - 2GHz Gate control
 - Pulse, step, pulse-step control
- Temperature Control & Measurement
 - 25-250° C, peltier heating
 - PID control

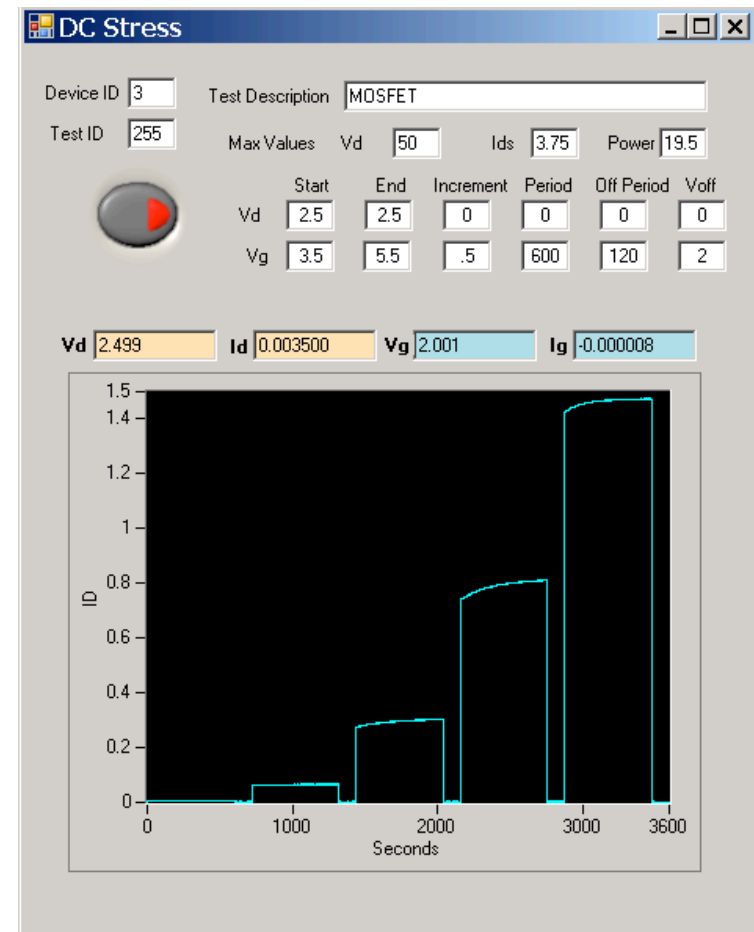
System Specifications & Features

- Device Characteristics
 - IV curves
 - Transconductance



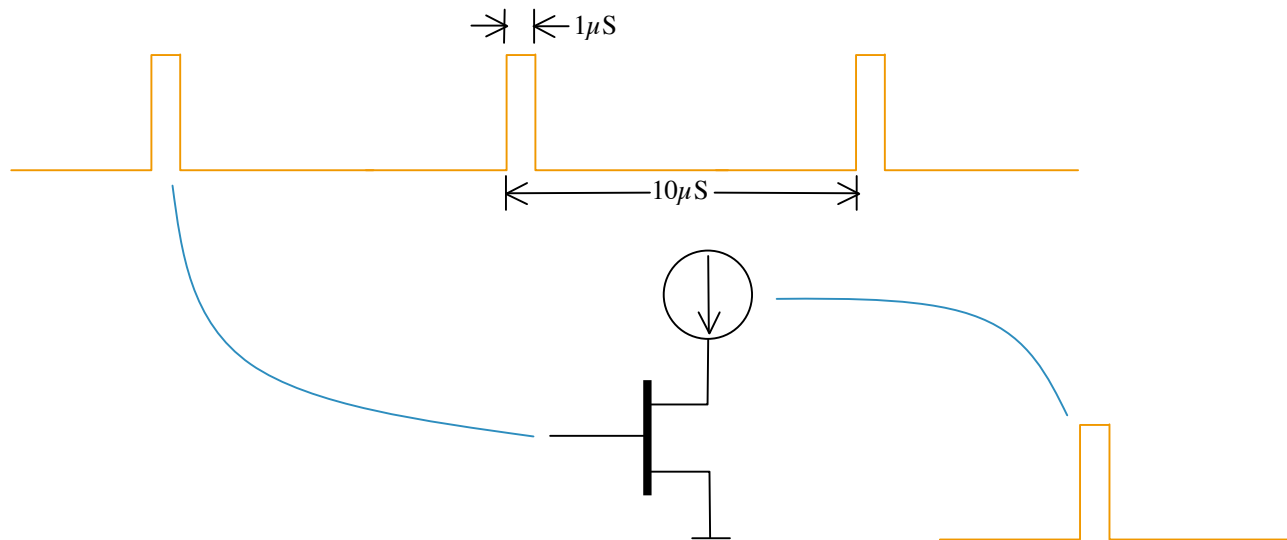
System Specifications & Features

- Long Term Stress Tests
 - DC & RF
 - Pulse, step, pulse-step
 - Data sampled every second
 - Gate voltage and current
 - Drain voltage and current



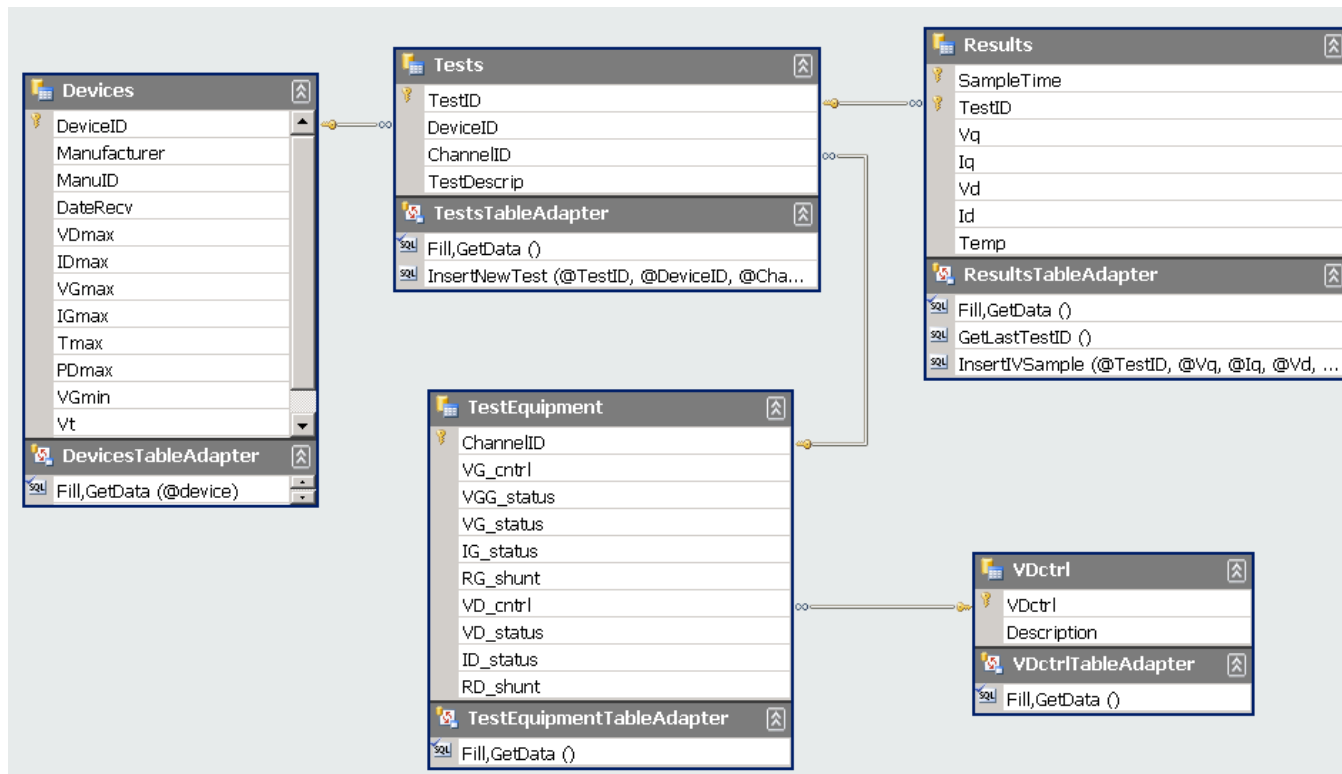
System Specifications & Features

- Gate and Drain Pulse Tests
 - High-speed 100kHz @ 10% duty cycle
 - Indicator of traps
 - Apply to gate V_g and measure I_d response



System Specifications & Features

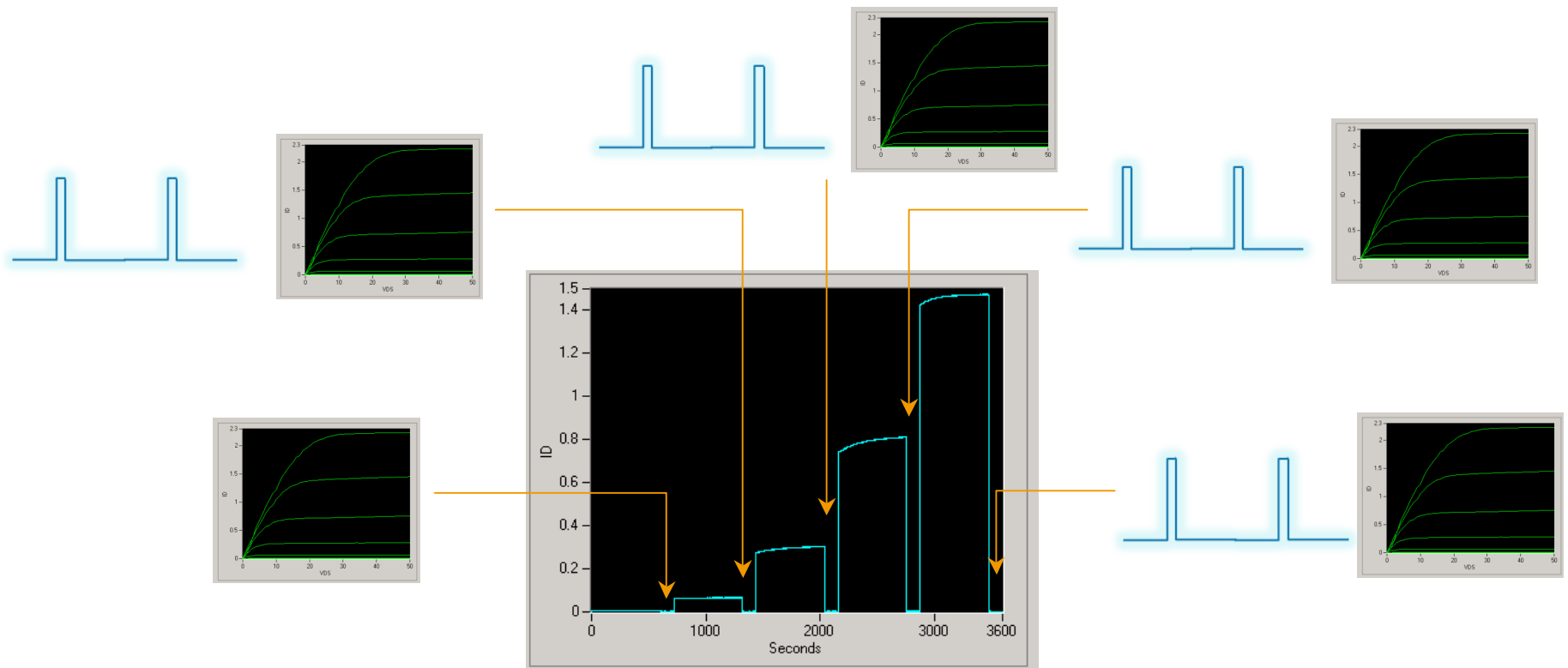
- Data Storage
 - Test Result Record: Timestamp, V_G , I_G , V_D , I_D , Temperature
 - SQL Server: Design flexibility, Data queries



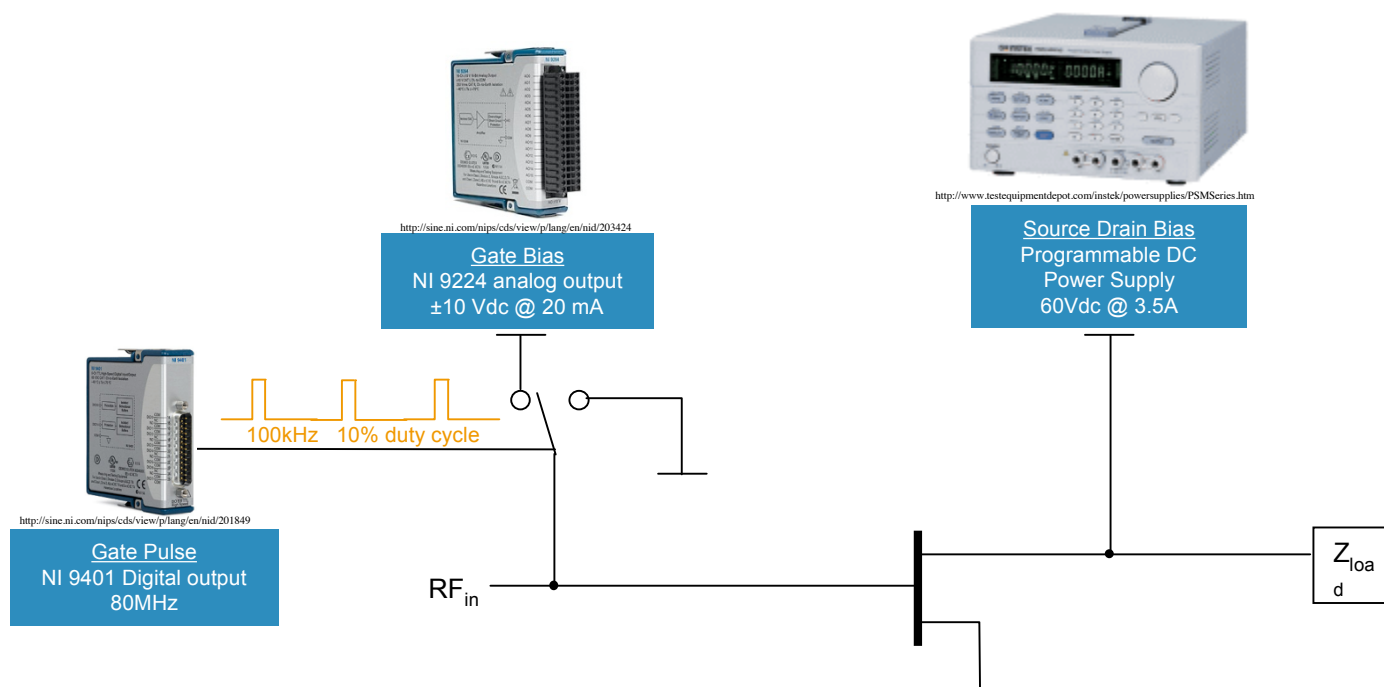
System Specifications & Features

■ Sequencing

- IV curve \Rightarrow DC Stress \Rightarrow Pulse \Rightarrow IV curve \Rightarrow DC Stress ...
- Pile plot IV curves

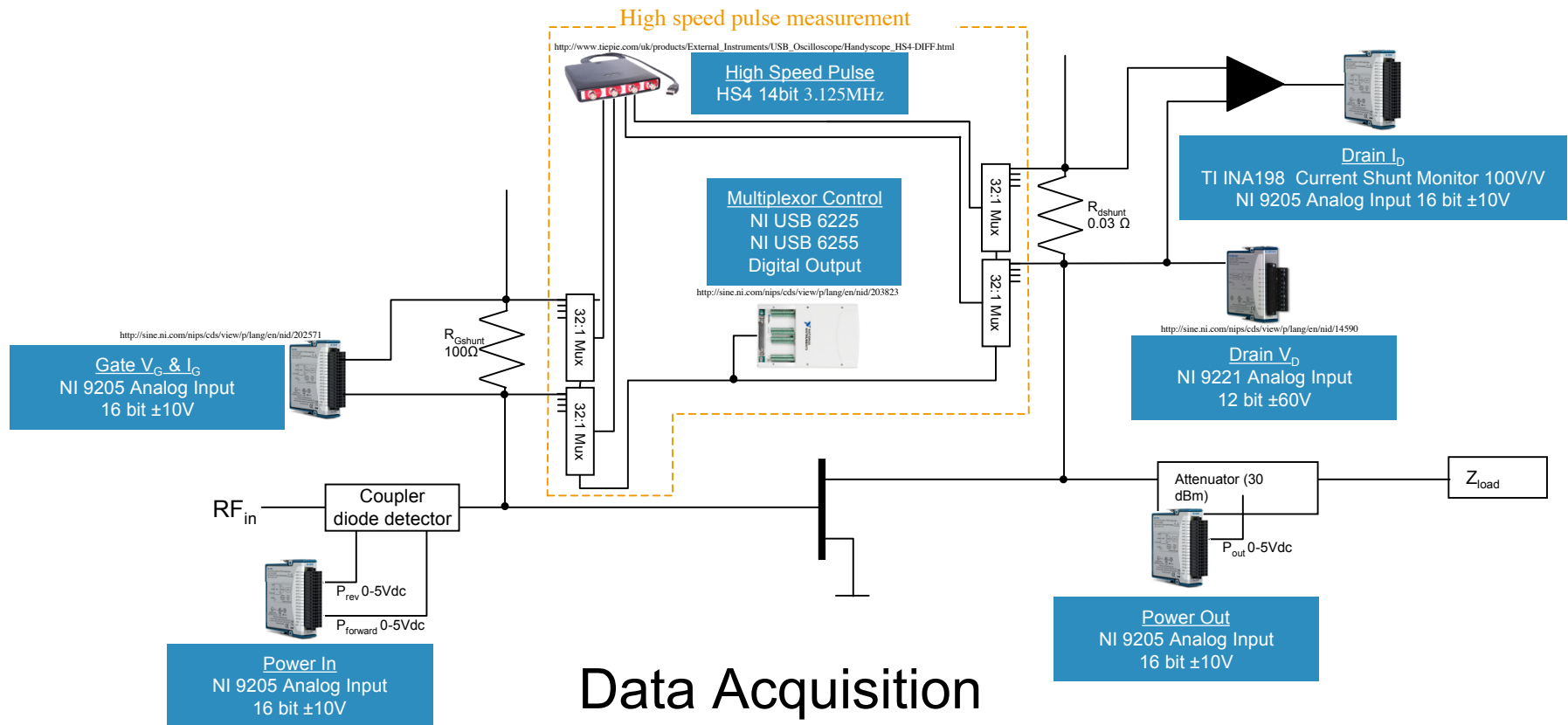


UF Semiconductor Reliability System

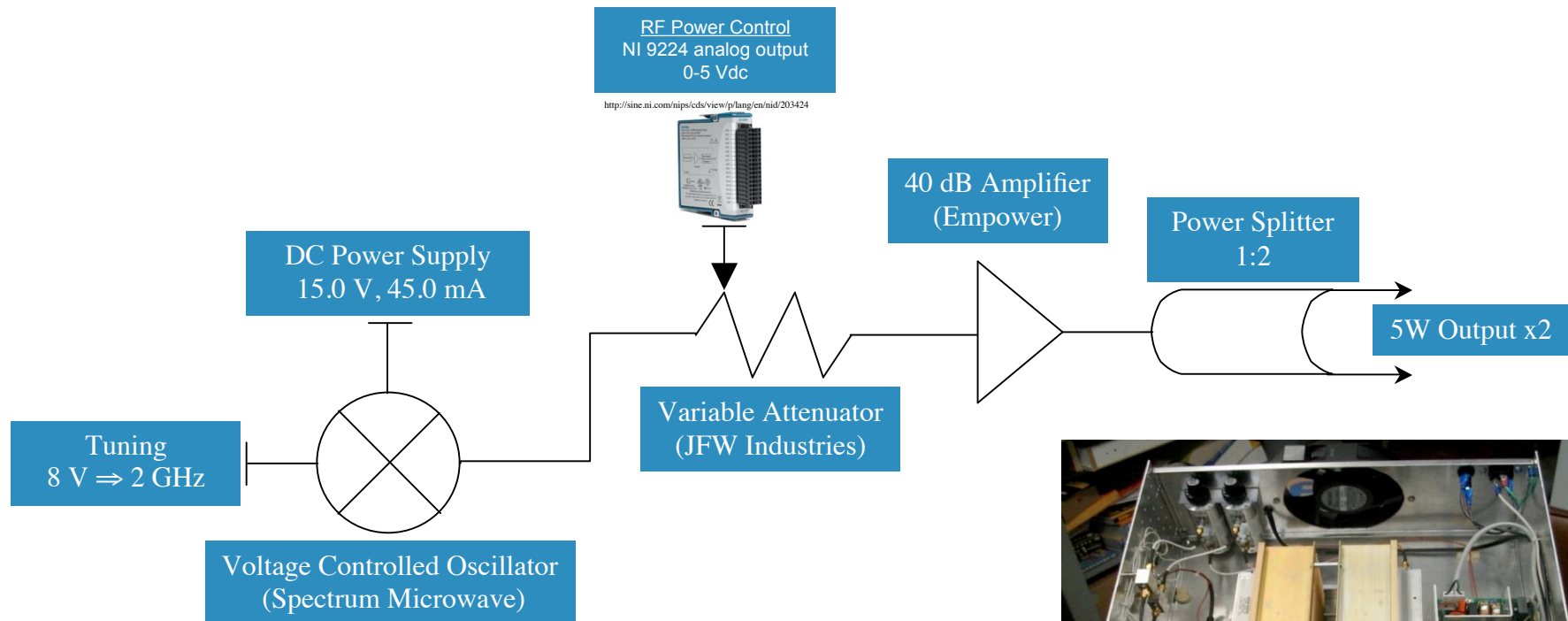


Bias & Control

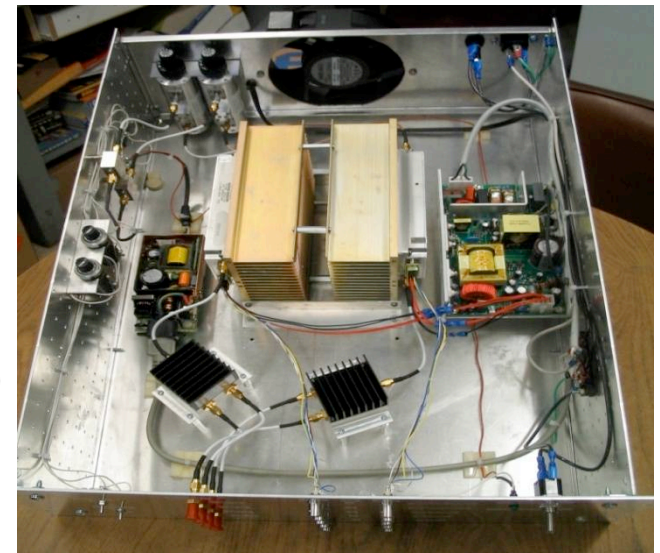
UF Semiconductor Reliability System



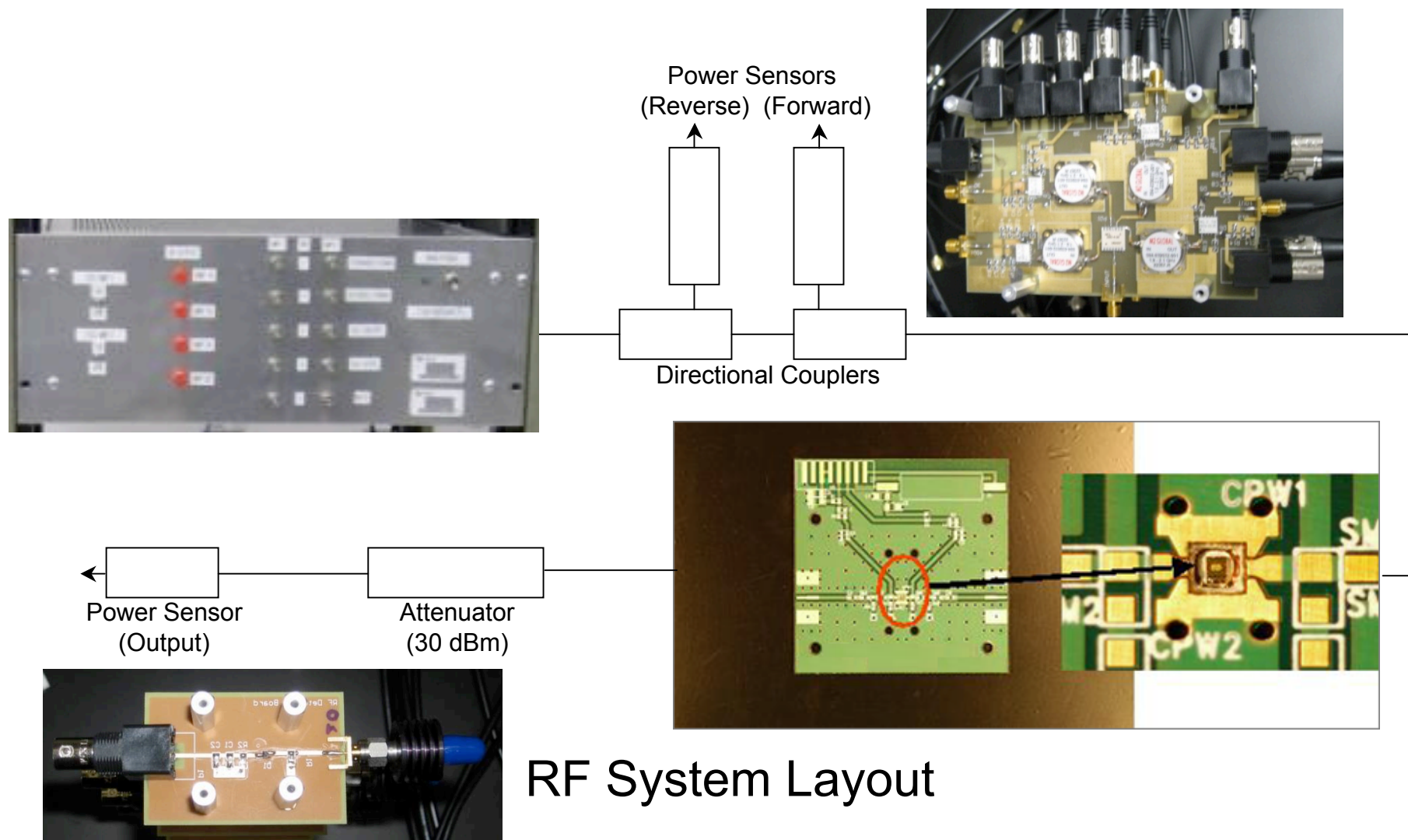
UF Semiconductor Reliability System



RF Power Supply (x4)

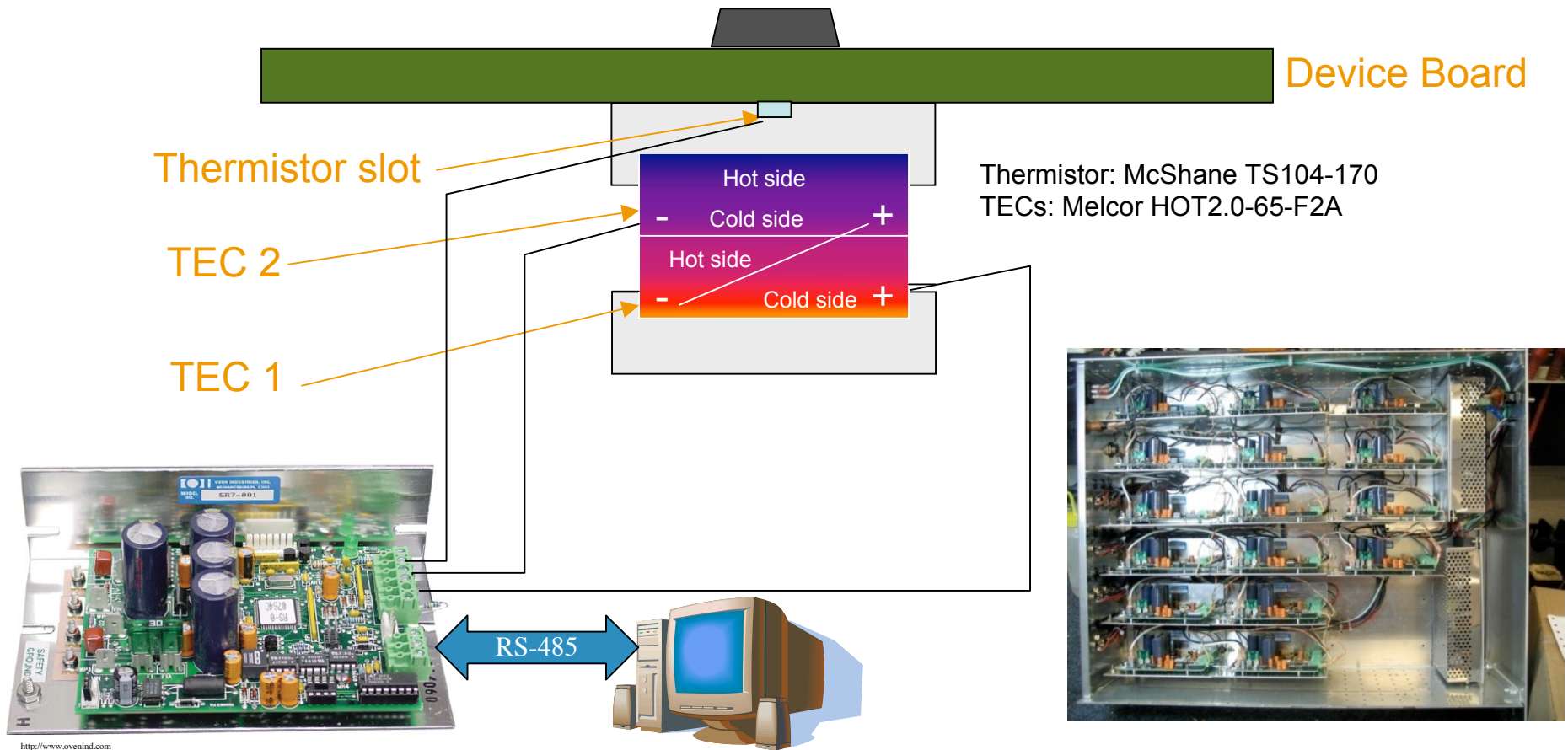


UF Semiconductor Reliability System



RF System Layout

UF Semiconductor Reliability System



Temperature Measurement and Control

Development

- ✓ Single Device Test: IV or DC
- Multiple Device Testing
 - Multi-threading single device tests
- High-speed Pulse Test
 - Integrate existing hardware
 - Implement Switching network
- Sequencing
 - Software development
- RF Testing
 - Tuning expertise
- Optical pumping
 - ★ PhD research topic